NOAA SECTORAL APPLICATIONS RESEARCH PROGRAM (SARP)
PROJECT ANNUAL REPORT

PROJECT TITLE

Estimating the impacts of complex climatic events: the economic costs of drought in Colorado, Nebraska and New Mexico

INVESTIGATORS
(Research team and full contact information)

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PROJECT YEARS **3**

TIME PERIOD ADDRESSED BY REPORT *(e.g., August 2002-March 2003)*

April 2009 – March 2010

I. PRELIMINARY MATERIALS

This study focuses on the economic losses associated with drought. Drought occurs every year across different regions of the United States. The amount usually quoted for annual average economic losses in the United States due to drought is $6-8 billion (FEMA 1995). This number likely underestimates the actual impact of drought and certainly is not representative of the last ten years. Economic estimates of the impacts of past droughts have been difficult to produce and are likely to be either significantly higher or lower for any given year than the FEMA estimate. Drought is also possibly the only natural hazard in which the secondary impacts may be greater than the primary impacts because of the way they filter through the economy. Few or no official loss estimates exist for the energy, recreation/tourism, forestry, and environmental sectors. As the momentum for implementing mitigation strategies to reduce future drought impacts increases, it is evident that the United States needs a concerted effort to quantify the economic impacts of drought in order to understand the monetary benefits of these proactive risk mitigation strategies.

A Project Abstract *(Limit to one page)*

B Objective of Research Project *(Limit to one paragraph)*

The study will be developed as follows: (1) Determine the geographical level of the analysis (Colorado, New Mexico, Nebraska, and Wyoming) and the level of detail (e.g., local business and tax impacts versus broad categories like agriculture, manufacturing, recreation, etc.), which affects the way one interprets the input-output coefficients of the localized IMPLAN model (there may be no substitutes for an agricultural input creating large multiplier effects locally, but statewide there may be plenty of alternative sources of supply, so statewide multiplier effects in some cases may prove to be less important). (2) Identify and characterize significant droughts over the past ten years *(Hayes, Pulwarty)*. (3) Carry out interviews and surveys with key state agency and industry personnel on specific direct impacts of past droughts and impacts-reporting criteria for water tourism, agriculture, and wildfires *(Pulwarty, Hayes, Howe)*. (4) Identify and measure directly imposed economic damages (e.g., direct losses of value added in agriculture and damage to agricultural capital assets including tree crops). This will also include looking at issues such as how payments from federal crop insurance reduce damages as seen from a state viewpoint but not from a national viewpoint *(Supalla, Howe, Ding)*. (5) Identify and measure indirect damages in sectors linked to agriculture, energy and tourism. Lost value-added income in sectors linked to agriculture, for example, can be counted for short-run impacts *(Team)*.

The investigators will begin by examining recent droughts and the sectors affected in Nebraska, Colorado, and New Mexico, with an emphasis on the 2002 drought. This was one of the driest years for each of the three states over the past 100 years. This drought was embedded in the longer-term dry period that extended from 1999-2004. From this, a list of sectors particularly vulnerable to droughts will be developed for each state. Information about the economic impacts will be based from available data, as well as information obtained from telephone surveys and semi-structured interviews to be conducted with state-level department personnel in the Tourism, Agriculture, Natural Resources and Water sectors. In some cases, information will also be collected and assimilated from state-level representatives of some of the federal agencies as well, particularly within USDA. The project will begin to understand direct and indirect losses and work to identify and understand various economic loss estimation techniques available, with the hope of encouraging a standardization of estimates so that official can begin to compare “apples to apples”, and be able to make decisions based on these estimates. Finally, the investigators would like to identify and/or develop methodologies that could be used by officials in order to estimate drought losses in various locations, sectors, and geographic scales around the country.

The investigators anticipate a variety of results and benefits for both the public and the scientific community as a result of this project. First, this study will provide the opportunity to begin to answer some very specific questions related to drought impacts on individual sectors that have rarely been addressed such as the energy, timber, and recreation and tourism industries, and others. Second, this project will encourage the development of standardized methodologies for estimating economic losses from droughts at national, regional, state, and local scales. It will also assist in developing standard methods for identifying, collecting, and quantifying drought impacts at these scales as well. Third, this project will be a step toward the development of national and regional assessments of drought conditions across the United States. Finally, this project supports both the National Integrated Drought Information System (NIDIS) and the proposed National Drought Preparedness Act (2005). Both of these national initiatives call for better drought impact assessment methodologies in order to improve drought mitigation and response actions in the United States. Mitigation and preparedness are the keys

C Approach (including methodological framework, models used, theory developed and tested, project monitoring and evaluation criteria) include a description of the key beneficiaries of the anticipated findings of this project (e.g., decision makers in a particular sector/level of government, researchers, private sector, science and resource management agencies) *(Limit to one page)*

D Description of any matching funds/activities used in this project *(Limit to one paragraph)*

The National Drought Mitigation Center also has complementary funding through a grant provided by the USDA's Risk Management Agency (RMA). This RMA funding partially supports Ya Ding's salary, as well as a subcontract to the University of New Mexico that supports Janie Chermak there.

II. ACCOMPLISHMENTS

A. Brief discussion of project timeline and tasks accomplished. Include a discussion of data collected, models developed or augmented, fieldwork undertaken, or analysis and/or evaluation undertaken, workshops held, training or other capacity building activities implemented. *(This can be submitted in bullet form – limit to two pages)*

Accomplishments during the second, third, and fourth quarters of 2009 (April-December):

- Ya Ding, Melissa Widhalm, and Mike Hayes have been meeting regularly throughout these quarters, discussing various issues related to drought economic impacts.
- In May, Ya Ding, Michael Hayes, and Melissa Widhalm submitted the article "Measuring Economic Impacts of Drought: A Review and Discussion" to the AMS journal - Weather, Climate and Society.
- Ya Ding, Karina Schoengold and Tsegaye Tadesse have finished the second-round of revision and resubmitted the article "The Impact of Weather Extremes on Agricultural Production Methods" to Journal of Agricultural and Resource Economics. This article was accepted by the journal and published in its December 2009 issue. The article was also published on the Digital Commons of UNL and has been downloaded more 100 times since the date of posting.
- Denise Gutzmer and Ya Ding reviewed the drought impacts on Ag-related businesses using the information from the Drought Impact Reporter (DIR). They discussed the possibility of using the DIR to generate preliminary estimates of drought impacts.
- Janie Chermak drafted an outline of drought impacts in New Mexico.
- Ya Ding and Karina Schoengold started to investigate the disaster payment information and its impact on farming practices.
- Ya Ding started to employ the county-level SPI and PDSI data to look at the drought impacts on corn production and farm income in Nebraska.

Accomplishments during the first quarter of 2010 (January-March):

- Ya Ding, Michael Hayes, and Melissa Widhalm have revised and resubmitted the article "Measuring Economic Impacts of Drought: A Review and Discussion" to the Disaster Prevention and Management Journal.
- Ya Ding and Karina Schoengold have met a couple of times to discuss the data requirements and modeling techniques for testing the impact of disaster assistance programs on farming practices.
- Tsegaye Tadesse has been working on the creation of county-level drought indices at different time-scales. These data will be used by Ya Ding to model the effects of drought on county-level farm income and crop production in Nebraska.
- Janie Chermak and Jee Hwang have drafted a report titled "The Economic Impact of Drought on Agricultural Sectors in New Mexico: Assessing a Simple Modeling Framework."

B. Summary of findings, including their potential or actual implications for efforts to develop applications, methods, and science-based decision support capacity/systems and to foster sustainable resource management and vulnerability reduction. *(Limit to two pages)*

During the past year, the investigators focused their attentions on several sector-specific studies. Ya Ding, Karina Schoengold, and Tsegaye Tadesse have investigated the impacts of weather extremes, such as drought and flood, on the adoption of alternative tillage practices in Nebraska and two neighboring states (South Dakota and Iowa). The adoption of no-till and other conservation tillage systems, which conserve soil moisture and reduce erosion, are feasible adaptations to increasing weather extremes under the impacts of climate change. A better understanding of how farmers adjust their production practices to reduce risks from drought and other hazards is essential for developing effective drought mitigation programs and reducing the rural vulnerability to drought.

Results reveal that farmers increase their adoption of conservation tillage following abnormally dry conditions of the past growing seasons; in addition, excessive rain in the spring poses a critical impediment to the use of no-till. Another important finding of our study is the negative effect of crop insurance on the adoption of no-till. Farmers whose income is protected by crop insurance have less incentive to invest in self-protection, such as no-till. Likely, we expect a similar effect from other policy variables such as disaster payments, since these payments also provide income protection to farmers. This research has generated a publication in the *Journal of Agricultural and Resource Economics*. For future research, more efforts will be put into the investigation of data requirements and modeling techniques for testing the impacts of disaster assistance programs on farming practices.

Janie Chermak and Jee Hwang have investigated the economic impacts of drought on agricultural sectors in New Mexico. They reviewed the drought history, economic activities, and water use in the state, and focused their analysis on three agricultural sectors: green chile peppers, dairy, and pecans. A standard analysis is performed on each sector, where annual output is modeled as a function of the drought index (SPI) among other factors. The estimated results are reasonable for milk and pecan, but less promising for chile peppers. The output functions are then used to estimate production loss and economic impact under varying drought conditions.

Finally, indirect and induced effects of drought are calculated by employing multipliers from previous I-O analyses.

The results suggest that there is not a substantial economic impact in the dairy industry, while pecan revenues are more susceptible and the percentage change in revenues increases with the severity of the drought. The results also suggest that technological changes and trade agreements (NAFTA) have impacted these sectors. Finally, the results illustrate the difficulty in developing a standard methodology to assess drought impacts across sectors and areas. While a simple and general methodology may generate more comparable results, the trade-offs are more restrictions and assumptions introduced, increased uncertainty in the results, and lost nuances of areas and sectors. Janie Chermak and Jee Hwang have put together a report of their work. A next step may be to expand the data for specific sectors to across states and/or regions and perform a similar analysis.

C. List of any reports, papers, publications or presentations arising from this project; please send any reprints of journal articles as they appear in the literature. Indicate whether a paper is formally reviewed and published. *(No text limit)*

1. Ya Ding, Karina Schoengold and Tsegaye Tadesse. "The Impact of Weather Extremes on Agricultural Production Methods" *Journal of Agricultural and Resource Economics* 34, 3(2009): 395-411.

2. Ya Ding, Michael Hayes, and Melissa Widhalm. "Measuring Economic Impacts of Drought: A Review and Discussion", submitted to *Disaster Prevention and Management*.

3. Janie Chermak and Jee Hwang. "The Economic Impact of Drought on Agricultural Sectors in New Mexico: Assessing a Simple Modeling Framework." A Draft Report.

D. Discussion of any significant deviations from proposed workplan (e.g., shift in priorities following consultation with program manager, delayed fieldwork due to late arrival of funds, obstacles encountered during the course of the project that have impacted outcome delivery). *(Limit to one paragraph)*

E. Where appropriate, describe the climate information products and forecasts considered in your project (both NOAA and non-NOAA); identify any specific feedback on the NOAA products that might be helpful for improvement. (bulleted response)

- The weekly U.S. Drought Monitor product has been valuable in assessments of drought conditions across Nebraska, Colorado, and New Mexico. This product is jointly produced by NOAA Climate Prediction Center and National Climatic Data Center, USDA, and the National Drought Mitigation Center.
- Precipitation data as inputs into drought indices such as the Standardized Precipitation Index (SPI) and the Palmer Drought Severity Index (PDSI) are also valuable.

III. GRAPHICS: PLEASE INCLUDE THE FOLLOWING GRAPHICS AS ATTACHMENTS TO YOUR REPORT

A. One Power point slide depicting the overall project framework/approach/results to date
B. If appropriate, additional graphic(s) or presentation(s) depicting any key research results thus far
C. Photographs (if easy to obtain) from fieldwork to depict study information (if applicable).

IV. WEBSITE ADDRESS FOR FURTHER INFORMATION (IF APPLICABLE)

V. ADDITIONAL RELEVANT INFORMATION NOT COVERED UNDER THE ABOVE CATEGORIES.